TECHNICAL MANUAL

QUALITY CONTROL PROCEDURES
HIGH DENSITY FUELS
GRADES JP-10 AND PF-1

(ATOS)

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INTRODUCTION

1. PURPOSE.

This technical order covers:

a. A fuel surveillance program to assure fuel quality throughout the life of the Air Launched Cruise Missile/Conventional Air Launched Cruise Missile (ALCM/CALCM) Program, and the Advanced Cruise Missile (ACM) Program.

b. The quality control procedures necessary to assure the proper receipt, storage and issue of High Density Synthetic Hydrocarbon Type Propellants, Specification MIL-P-87107, Grade JP-10; Propellant, Priming Fluid, ALCM/CALCM Engine, Specification MIL-P-87173 (USAF) Grade PF-1.

2. SCOPE.

These instructions are intended to assure fuel quality from the initial receipt, while in dormant storage, and after loading for each missile until fuel change out is accomplished.

CHAPTER 1
GENERAL

1.1 GENERAL SAFETY AND ENVIRONMENT CONSIDERATIONS.

Petroleum products are hazardous due to their toxic, explosive, flammable, and environment damaging natures. Prescribed safety precautions will be strictly followed for the safety and protection of personnel, equipment, and the environment. Fire hazards are present wherever petroleum products are handled due to leaks, spills, vapor accumulation, improper grounding/bonding of equipment, or ignition from a heat source. Leaks or spills must be eliminated to prevent pollution of waterways and underground water tables. CFR Title 40, Part 112.7, GUIDELINES FOR THE PREPARATION AND IMPLEMENTATION OF A SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN, provides guidance on establishing an adequate spill prevention control program. All spills will be promptly reported to the applicable agencies (fire department, safety office, bioenvironmental representative, etc.). AFI 23-201 and AFOSH Standard 91-38 outline general safety guidelines to be followed. T.O. 42B-1-23, titled MANAGEMENT OF RECOVERABLE AND WASTE LIQUID PETROLEUM PRODUCTS, provides guidance in the collection, segregation, and disposition of recoverable and waste liquid petroleum products.

1.2 QUALITY CONTROL PROCEDURES.

Applicable information in T.O. 42B-1-1 should be used for general guidance. Questions or comments pertaining to the procedures specified in this technical manual should be addressed to: Det 3, WR-ALC/AFTH, Wright-Patterson Air Force Base, OH 45433-7632, DSN 785-8070, through your Major Command Fuels Management Office.

1.3 RESPONSIBILITIES.

The training and indoctrination of assigned personnel and development of operating checklists and procedures should be accomplished jointly by Base Fuels Management personnel and the using activity. After receipt of fuel, the using activity is responsible for quality control. Base Fuels Management will provide technical assistance as required, perform required base level testing, and assist in disposition of off-specification product.

CHAPTER 2
TRANSPORTATION

2.1 METHOD OF TRANSPORTATION.

a. JP-10 is delivered by tank truck or in 55-gallon drums.

b. PF-1 is supplied in one gallon pails, 55-gallon drums and by tank truck.

c. Tank Trucks – the following tank trucks are approved for transportation of JP-10, PF-1. Commercial tank trucks with Department of Transportation (DOT) Specification MC306, MC307, and MC312 tanks made of stainless steel, aluminum, or mild steel. Mild steel tanks must have an interior epoxy lining of material conforming to MIL-PRF-4556. Each base will provide at least one 15-foot teflon-lined, off-loading hose to hook up delivery truck tank to the horizontal off-loading headers. If local design conditions require more than 15 feet of off-loading hose, additional hose will be acquired. Three inch diameter hoses, couplings, and headers are standard in Air Force fuel systems. Facilities that do not have horizontal off-loading headers may require an elbow to accomplish off-loading. Any requirements for unique or special adapters, fitting, etc. should be brought to the attention of Det 3, WR-ALC/AFTH, DSN 785-8070, 90 days prior to scheduled JP-10 deliveries. T.O. 37A-1-101 provides hose storage and handling instructions.

d. 55-Gallon Drums – drums shall conform to PPP-D-729, Type II. Each drum shall contain 54 gallons of product. The interior of each drum shall be epoxy lined.

e. One Gallon Pails – pails shall conform to DOT Specification 17C, 24-gauge steel, with tin plated steel inner seal, and 25mm screw cap with neoprene liner, epoxy resin interior lining, 15 psig internal pressure (NSN 8110-00-128-6819).

2.2 SAMPLE SUBMISSION TO OFF-BASE LABORATORIES.

The following containers may be used to ship samples to off-base laboratories:

a. Container, Fuel Sample (NSN 8110-00-128-6819) – one gallon steel can meeting Specification PPP-P-704, Type I, Class 4, with epoxy coating, made in accordance with DOT Specification 17C. This sample can is designed for one time air shipment of fuel samples and does not require an overpack. These sample cans may be cleaned and reused for base level sampling.

b. Kit, Fuel Sampling, locally procured (NSN 8115-00-719-4111) – this kit is reusable and meets Specification MIL-K-23714. It consists of four clear one quart bottles with caps, cushioned in foam and is suitable for air shipment of aviation fuel samples. The overpack (NSN 8110-00-254-5715) consists of a metal container conforming to Specification MIL-D-6054 and Drawing No. MS24346-1.

CHAPTER 3
RECEIPT

3.1 RECEIPT OF FUEL.

Upon receipt of bulk JP-10/PF-1 check the shipping and receiving documents (DD Form 250) accompanying each shipment for contract number, contractor's name, product/specification, product nomenclature, seal numbers, and lot or batch numbers to assure that the grade of fuel, quantity, and serial numbers of the seals and tank truck agree with the shipping document.

3.2 TANK TRUCK SAMPLING PRIOR TO DISCHARGE.

a. Samples will be taken in accordance with Paragraph 4.6, Step a and Paragraph 4.8, Step a prior to off-loading product into bulk storage. Values should correlate with DD Form 250 within the following reproducible limits:

- API Gravity ±1° corrected to 60°F
- Flash Point ±6°F

Additionally, particulates must be less than 3.8 milligrams/gallon (mg/gal).

b. If sample results show the product fails any of the above limits, contact Det 3, WR-ALC/AFTH, DSN 785-8070, for disposition instructions.

3.3 FUEL TRANSFER TO BULK STORAGE.

Fuel is gravity fed into one dedicated issue tank using teflon-lined hose(s) provided by each base (see Paragraph 2.1, Step c). Obtain a 2-gallon sample in accordance with Paragraph 4.6, Step d for complete specification analysis. The tank will be placed in QC hold status using AF Form 1492 until laboratory test results are received by Base Fuels Laboratory personnel from Det 3, WR-ALC/AFTLA. Approval must be obtained from Det 3, WR-ALC/AFTH prior to releasing tank(s) for use.

CHAPTER 4
QUALITY CONTROL

4.1 FUEL PROPERTIES.

a. JP-10 is a high density hydrocarbon fuel, composed solely of exo-tetrahydrodi(cyclopentadiene). Its flash point is 130°F minimum and it has a specific gravity of 0.935 to 0.943 (19.8 to 18.5 API). JP-10 is colorless.

b. PF-1 is a high density, colorless hydrocarbon fuel composed of MCH and JP-10. It has a flash point range of 60 to 80°F and specific gravity of 0.900 to 0.930 (25.7 to 20.7 API)

4.2 TYPE OF TESTS.

Quality control of JP-10, PF-1 includes both full specification and base level tests. Specification testing is done by the area Aerospace Fuels Laboratories in accordance with MIL-P-87107 for JP-10 and MIL-P-87173 for PF-1. (See T.O. 42B-1-1 for location of area laboratories.) Base level tests are performed by Base Fuels Laboratories and include: visual, API gravity, free water, particulates, and flash point.

4.3 QUALITY CONTROL PROCEDURES AT BASE LEVEL.

New product receipts (both bulk and packaged), except PF-1 in 1-gallon cans, require full specification analysis at an Aerospace Fuels Laboratory. Once product is accepted, periodic base level testing is necessary to assure quality in dormant storage, in the fueling/defueling set, and in the priming unit. Notify Det 3, WR-ALC/AFTH if testing indicates fuel quality is suspect. Area laboratory analysis is required for initial receipt of fuel, product defueled from missiles and stored in used fuel tank, and fuel obtained from Analytical Condition Inspection (ACI) and Operational Test Launch (OTL) missiles under the Fuel Surveillance Program.

4.4 GENERAL SAMPLING PROCEDURES.

a. The person taking the sample will ensure that a truly representative sample is taken. Cleanliness of equipment and the sampler's hands is extremely important. Use only lint-free cloths/materials to wipe bottles. Bottles specifically cleaned for sediment or fiber analysis will not be rinsed with the product before sampling.

b. Underground tanks can be sampled from several locations by various methods. The preferred method is an in-line sample taken downstream of filter separator during recirculation of product. Sampling through manhole covers or gauge hatches that do not extend to the bottom of the tank are other sampling points; however, this is not recommended as standard practice. Do not take samples through a storage tank cleanout line or through gauge hatches that extend to the bottom of the tank, since such samples will not be representative of the product in the tank.

c. Do not sample drums by tilting and using a funnel placed in the sample can. Use a tube or drum thief. For additional information on sampling, see ASTM D 4057, Manual Sampling of Petroleum and Petroleum Products.

4.5 TYPES OF SAMPLES.

The type of sample taken depends on the particular tests required and the location being sampled. The following defines various types of samples:

In-line Sample	From a line through which product is flowing which gives a representative average of the stream.
All Level Sample	Obtained by submerging a closed sampler to a point as near the draw-off level as possible, then opening the sampler and raising it at such a rate that it is nearly full as it emerges from the liquid.
Bottom Sample	From the lowest point of the tank contents.
Tube or Thief Sample	Obtained as a core sample, or spot sample from a specified point in a container. An all level sample from a drum can be taken with these samplers.

4.6 SAMPLING REQUIREMENTS.

a. Tank Truck – tank trucks will be sampled upon receipt. A one quart bottom sample obtained from the truck manifold is visually examined for color, sediment, and free water by Base Fuels Laboratory personnel in accordance with Paragraph 4.8, Step a. A 1-gallon all level sample is then taken and tested by Base Fuels personnel for API gravity, flash point, and particulates.

b. Packaged Product (55-gallon drums) – upon receipt of product, a 1-gallon composite sample representative of the packaged drum lot will be taken in accordance with ASTM D 4057 and sent to the area Aerospace Fuels Laboratory for full specification analysis (except particulates). All

product will be placed in QC hold pending lab results.

c. Packaged Product, PF-1 (1-gallon cans) – no testing is required upon receipt. Product is tested for compliance with specification requirements before shipment from the contractor's plant. PF-1 cans, upon cleaning after initial use, are suitable for reuse in base level testing only.

d. Bulk Storage.

(1) New or Recycled Product – product should be placed into empty or near empty tanks. If an empty storage tank is not available, bulk JP-10 and PF-1 shipments may be unloaded on remaining JP-10 and PF-1 stocks, respectively. However, the bulk tank will be resampled after each tank truck delivery. Allow 12 hours settling time before sampling. A 2-gallon sample is then taken downstream of the filter separator from the recirculation loop of the tank and submitted to the area Aerospace Fuels Laboratory for full specification analysis on the Type A System, see Paragraph 4.6, Step g(1). Place the tank in QC hold status pending laboratory results. Types B and C systems will be sampled from the refueler and tested according to Paragraph 4.6, Steps g(2) and (3) respectively.

(2) Active Product Issue Tank – a sample will be taken from the recirculation loop, downstream of the filter separator, once weekly. Test for water and particulates. Limits are 5 ppm free water (AEL/AquaGlo method) and 1.0 mg/liter (3.8 mg/gal) particulates.

(3) Dormant Storage (JP-10) – a 2-gallon sample is taken every 90 days from the recirculation loop, downstream of the filter separator, and sent to the area laboratory for full specification testing. A one gallon sample is also taken at the same time and sent to Base Fuels Laboratory. Base Fuels Laboratory will test for water (AEL/AquaGlo), particulates, and API Gravity in accordance with procedures in T.O. 42B-1-1.

e. Fueling/Defueling Set (Conditioning Unit) – sample after each conditioning tank filling and filtering operation. A one gallon sample will be taken while the fuel is being recirculated using the in-line sampler in the by-pass mode. (There is not sufficient pressure to take a true in-line sample using the matched weight monitor.) The sample will be analyzed in the Base Fuels Laboratory for particulates (bottle method). Particulate contamination at this point shall not exceed 2.0 mg/gal.

f. Priming Unit – purged PF-1 shall be collected in a safety can for disposal. PF-1 can be downgraded to JP-8 by blending one part of priming fuel to at least 10 parts JP-8.

g. JP-10 Defueled from Missile – existing ALCM/CALCM fuel storage systems were not designed and built to the same plan. There are three types of systems in place. These have been designated as Types A, B, and C systems and are described as follows:

(1) A Type A system has two issue tanks, two defuel tanks, two filter separators, recirculation capability, and allows for fuel movement between all four tanks. This is the ideal system and no major fuel quality problems should occur due to the basic design of the system. Defueled JP-10 is placed in bulk defuel tank. When the defuel tank is about 75% full, switch defueling to other defuel tank and take a 2-gallon sample downstream of filter separator while product in tank is recirculated. Send sample to the area Aerospace Fuels Laboratory to determine if fuel meets MIL-P-87107 requirements. Place tank in QC hold status pending testing results. If the fuel meets specification requirements, pump into an empty issue tank. Off-Specification JP-10 will be downgraded to JP-8 (1 part JP-10 to at least 10 parts JP-8). Contact Det 3, WR-ALC/AFL, DSN 427-9896 for fuel accounting instructions.

(2) A Type B system has two issue tanks, one defuel tank, a filter separator downstream of issue tanks, no filter separator for the defuel tank, and fuel cannot be moved from defuel tank to issue tanks. A refueler with filter separator must be prepared and dedicated to JP-10 defuel storage to allow uninterrupted defueling operations. When approximately 4,000 gallons of defueled JP-10 have accumulated in the defuel tank, the JP-10 shall be pumped into the refueler. The product will then be circulated within the refueler. Sampling and testing instructions as found in Paragraph 4.6, Step g(1) will apply. Product in refueler is held in QC hold status pending testing results. If product in refueler meets specification requirements, it shall be gravity discharged through the refueling unit tank bottom loader or defuel stub into issue tank. Off-Specification JP-10 will be downgraded to JP-8 (1 part JP-10 to at least 10 parts JP-8).

NOTE

Instructions regarding acquisition of refuelers and preparation of refuelers for JP-10 service will be requested from HQ ACC/LGSF, DSN 574-7121.

(3) A Type C system has two issue tanks, one defuel tank, no filter separators, no recirculation capability, and no fuel movement from tank to tank. A Type C system in order to become operational must have a refueler with filter separator prepared and dedicated to JP-10 defuel storage to allow uninterrupted fueling/defueling operations. A filter separator must be placed downstream of the issue tanks. When approximately 4,000 gallons of purged JP-10 have accumulated in the defuel tanks, the JP-10 shall be pumped into the refueler and circulated within the refueler. Sampling and testing instructions in Paragraph 4.6, Step g(1) are applicable. If the product in refueler meets specification requirements, it shall be gravity discharged through the refueler tank bottom loader or defuel stub into an issue tank. Off-Specification JP-10 will be downgraded to JP-8 (1 part JP-10 to at least 10 parts JP-8).

(4) Locally Assigned Batch Numbers for Defueled JP-10. Each Integrated Maintenance Facility (IMF) will be responsible for assigning and recording a local batch number for each batch of defueled JP-10 before sending sample to laboratory. The batches will be numbered with the IMF organizational number followed by a hyphen and at least two digits beginning with 01. For example, the first defueled batch from 319IMF will be number 319IMF-01. Successive batches will be 319IMF-02, -03, etc. Technical Repair Center Depots will also assign local batch numbers reflecting the organizational symbol of submitter and successive two-digit numbers. The test results (On-Spec, Off-Spec) and final disposition (re-issue, downgrade to JP-8) will also be recorded with the batch number.

(5) The nineteen year service life for JP-10 must be based upon the oldest JP-10 in a commingled JP-10 batch. For example, if a missile originally fueled in 1981 is the oldest missile defueled into a commingled batch, the fuel service life of the entire batch begins in 1981. The fuel service life of JP-10 will depend on how long defueled, commingled batches of JP-10 continue to pass full specification analysis.

h. Fuel Surveillance Program.

(1) Scope – maintenance plans are based upon a fuel service life in the AGM-86B and the AGM-129 Air Vehicle (AV) so that change out of fuel can be accomplished in the field concurrently with the AV periodic inspection. To achieve a nineteen year refueling interval, strict limits on total water (10 ppm) and particulate contamination (2.0 mg/gal) have been imposed on fuel in the missile. Thus, a fuel surveillance program will be initiated to monitor fuel cleanliness and stability with age by testing fuel and recording data from the following:

- Samples from each ACI missile inspected
- Samples from each removed OTL missile
- Special samples as required

This surveillance program is part of the Effectiveness Verification/Improvement Program (EVIP) and will be accomplished at the depot maintenance facility (for ACI missiles) and at the recovery site (for OTL missiles).

(2) Tests Required.

(a) Full specification analysis on JP-10 samples.

(b) Flash point on PF-1 samples (ACI missiles only).

(3) Sampling.

(a) A 1-gallon JP-10 sample will be taken from the drain line while the missile is being defueled after sufficient fluid has been drained to purge the line of residual fluid and/or contaminants (approximately one minute). See T.O. 21M-AGM86-1-1 and T.O. 21-AG129-31 for defueling procedures. The 1-gallon sample is sent to the area Aerospace Fuels Laboratory for full specification analysis. Include missile tail numbers on documentation that accompanies the fuel sample.

(b) The ALCM/CALCM engine contains approximately one pint of PF-1 fuel. Drain the fuel into a clean one quart glass bottle and analyze for flash point. See T.O. 21M-AGM86-2-1 for defueling procedures.

(c) Fuel remaining in OTL missiles after samples have been sent to the area Aerospace Fuels Laboratory will be downgraded to JP-8 (1 part missile fuel to at least 10 parts JP-8).

(d) Reporting Results – a copy of each test report is sent to Det 3, WR-ALC/AFTH, DSN 785-8070, and OC-ALC/PSMRT.

4.7 QUALITY CONTROL TESTS REQUIRED.

a. Full Specification – in accordance with MIL-P-87107 for JP-10, MIL-P-87173 for PF-1.

b. Base Level – consists of visual inspection, API gravity, water, particulates and flash point, and fibers when applicable (see Table 4-1, Source 10).

4.8 TEST METHODS.

a. Visual Inspection.

(1) Use a clean one quart round or rectangular glass bottle that has been cleaned with soap, rinsed with hot water, rinsed with distilled or demineralized water, then oven or air-dried.

(2) Visual examination consists of color, sediment, and free water.

(3) The fuel sample should be clear and bright. Very fine suspended solids or water will render the product hazy. Check for sediment or water contamination by swirling the sample so that a vortex is formed. Any sediment or water present will accumulate on the bottom of the bottle directly beneath the vortex. Sediment should be no more than a slight smudge if picked up on a fingertip.

(4) If the visual inspection procedure indicates contamination of sample, drain fuel in one gallon increments until fuel passes visual inspection. If fuel does not pass visual inspection after draining 20 gallons, contact Det 3, WR-ALC/AFTH, DSN 785-8070, for disposition instructions.

b. API Gravity Determination – API gravity is determined by a hydrometer (NSN 6630-00-265-7610) and converted to API at 60°F. Refer to T.O. 42B-1-1 for test procedures. API specification limits are as follows: 18.5 to 19.8° API for JP-10, 20.7 to 25.7° API for PF-1.

c. Water Content AEL/AquaGlo Method – refer to T.O. 42B-1-1 for test procedures. There is no specification limit on water content; however 10 ppm total water maximum has been established for the ALCM/CALCM fuel tank. Fuel of this low water content will absorb water from the air rapidly at room temperature and approach the equilibrium dissolved water content of approximately 50 ppm. The fueling/defueling set is designed to remove water by filtration through a desiccant. A hygrometer on the fueling/defueling set enables a continuous measurement of the water content. Because of the total water limitations, a 5 ppm free water maximum (determined by the AEL/AquaGlo Method) has also been established for fuel prior to entering the fueling/defueling set.

d. Solid Contamination – two methods are available for determining solid contamination: matched-weight monitor method (refer to T.O. 42B-1-1) and bottle method (refer to T.O. 42B-1-1). Limits for JP-10, PF-1 are: 1.0 mg/liter (3.8 mg/gal) maximum for specification limit, 1.0 mg/liter (3.8 mg/gal) maximum for downstream of filter separator and 2.0 mg/gal maximum for conditioning unit (JP-10 only).

e. Flash Point – flash point, either Pensky-Martins or Setaflash Methods, will be run. Refer to T.O. 42B-1-1 for test procedures. Flash point specification limits are 130°F for JP-10 minimum, 60° to 80°F for PF-1.

f. Fiber Test – perform visual fiber test after change of filter elements (see Table 4-1, Source 10).

Table 4-1. Minimum Sampling and Testing Requirements

Sample Source	Frequency	When or Where Sampled	Test Required	Sample Volume
1. Tank Truck	Upon Receipt	Prior to off-loading. See Paragraph 3.2. From bulk tank. See Paragraph 3.3.	Visual (qt) Base Level (gal) Full Spec	1 qt and 1 gal 2 gal
2. Packaged Product (55-gal drums)	Upon Receipt	Composite sample representative of packaged drum lot in accordance with ASTM D 4057.	Full Spec (except particulate)	1 gal
3. Active Issue Tank (JP-10)	Weekly	Sample from recirculation loop downstream of filter separator.	Particulates and water	1 gal and 300 ml
4. Dormant Storage (JP-10)	Every 90 days	Sample from recirculation loop downstream of filter separator.	See Paragraph 4.6, Step d(3)	2 gal
5. Fueling/Defueling	After each conditioning tank filling	See Paragraph 4.6, Step e.	Particulates (bottle method)	1 gal
6. Product Defueled from Missile (JP-10)	When defuel tank is full	Sample downstream of filter separator during recirculation.	Full Spec – see Paragraph 4.6, Step g	2 gal
7. ACI Missile (JP-10)	See Paragraph 4.6, Step h	See Paragraph 4.6, Step h(3)(a).	Full Spec	1 gal
8. OTL Missiles	See Paragraph 4.6, Step h	See Paragraph 4.6, Step h(3)(a).	Full Spec	1 gal
9. ALCM/CALCM Engine (PF-1)	See Paragraph 4.6, Step h	See Paragraph 4.6, Step h(3)(b).	Flash point	1 pint
10. Filter Separator	After Element Change	Downstream of filter separator while fuel being circulated.	Fiber count – no more than 10 visible fibers per quart sample (T.O. 42B-1-1)	1 qt